MDA User Guide

Creating Multi-Dimensional Audio Assets

A Senior Project Presented to
The Faculty of the Liberal Arts and Engineering Studies Department
California Polytechnic State University, San Luis Obispo

In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Arts
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Introduction

Creative industries are always developing ways to make entertainment more immersive to create a more realistic experience for the audience. One well known example would be 3-D movies, where certain graphics in a film are given depth. Sound is also becoming more immersive through the introduction of multi-dimensional audio. Multi-dimensional audio is an object based audio codec, and it is different than surround sound because it is not limited to a specific number of channels. Instead, sound objects are positioned independently and mapped to any configuration of speakers during playback ("DTS:X"). DTS, Inc. is a consumer audio company, and recently they came up with their own software to create and play back multi-dimensional audio called the MDA Mixer Kit, which is part of their immersive sound technology called DTS:X ("DTS:X").

MDA has a couple of competitors in spatial audio. A number of theaters have installed Dolby Atmos, which is Dolby Digital's version of multi-dimensional audio. However, the Atmos system is limited because it requires very expensive equipment and is not compatible with different speaker configurations. Auro-3D is another spatial audio codec made by Auro Technologies, but it also requires special hardware for playback ("Auro-3D"). DTS:X has many advantages such as its backwards compatibility, flexibility in terms of number of loudspeakers and their configuration, and great audio quality ("DTS:X").

Cal Poly is lucky enough to have a good relationship with DTS. In the spring of 2013, DTS donated a set of loudspeakers to Cal Poly to be installed in the Game Design Lab in the Computer Science building, room 14-255. Sound foam was also put up and a computer was designated to become the audio computer, but that was the end of the work on this project. The intended purpose of installing the speakers in the lab was to create a space where students could create multi-dimensional audio using the MDA Mixer Kit software made by DTS, but that vision wasn't realized in the initial stage of the project. Another problem besides not having the software was that no documentation existed for MDA. DTS:X was just announced to the public in April 2015, but only hardware to play back MDA files was revealed. The software is still in its beta stage, so only certain organizations currently have access to it.

Research Question: How can we use speakers donated by DTS to create a multi-dimensional audio mixing station and how can we make it easier for students to use it in the future?

Deliverables

The purpose of my project is to put the speakers in the Game Design Lab to good use and to make it possible for students to use them. In order to achieve both of these objectives, my project contains the following deliverables:

Functional Workstation in Game Design Lab

In order for students to be able to use the loudspeakers for their intended use, the mixing station in the Game Design Lab must have the necessary hardware and software. My first deliverable is to have a working 3-D sound station running the DAW (digital audio workstation, which is a type of software used in audio production) Avid Pro Tools with the DTS MDA (multi dimensional audio) plugin that students can use to create 3-D sound for multimedia projects. The entire system consists of the speakers that DTS donated, which were installed in 2012, an audio interface to allow the computer to send audio signals to the speakers, and a computer with Pro Tools and the MDA Mixer Kit software.

MDA Mixer Kit User Guide

My second deliverable is to create a user guide to assist the users in creating 3-D audio for their projects. The guide should be allow students with or without sound design experience to create multi-dimensional audio assets for multimedia projects such as movies or video games. The guide should cover all of the features within the MDA software and a basic overview of Pro Tools with all of the information someone would need to know to use the MDA Creator plug-in. No documentation currently exists for the MDA Mixer Kit, so my guide will be the first user support documentation for this technology.

Literature and Technology Review

For my literature and technology review, I researched relevant technologies to my project. Even though I didn't use all of the information that I learned through the research process, it was helpful to have an understanding of related technologies when I was learning to use the MDA Mixer Kit and creating the guide.

Traditional Surround Sound Mixing Technique

Surround sound mixes are typically made for 5.1 or 7.1 sound systems, with five or seven loudspeakers placed around the room and a subwoofer for low frequency effects (LFE) objects. 5.1 surround consists of the center channel, left and right channels, and left and right back channels. 7.1 surround consists of the center, left and right front, left and right side, and left and right back channels. Traditionally, the dialogue is placed in the center of the screen, the music in the back, and the sound effects on the sides (White). When mixing for multi-dimensional audio, it is important to have a foundation in traditional surround sound mixing to know where to place certain sounds. For example, dialogue should mostly be placed near the center of the screen because so that attention is drawn to the characters who are speaking. Low frequency effects are also sent to the subwoofer in both surround sound and MDA mixing (White).

Vector Based Amplitude Panning (VBAP)

The first paper on Vector Based Amplitude Panning was published in 1997 by a Finnish audio engineer and researcher named Vill Pulkki, who specialised in three-dimensional sound and virtual acoustics. In his paper titled "Virtual Sound Source Positioning Using Vector Based Amplitude Panning," he covers a multitude of topics pertaining to vector based amplitude panning, which is a method of creating three-dimensional audio. When a sound is three-dimensional, it can sound like it's coming from anywhere in the room, which is also known as a virtual sound source. The purpose of Pulkki's paper is to describe how to create virtual sources for sounds using two or more speakers in any configuration. Pulkki also delves into the math behind vector based amplitude panning,

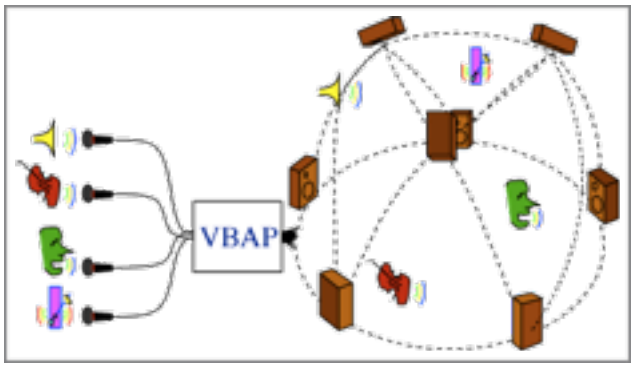

Figure 1. VBAP diagram (Pulkki)

describes how to implement it, and gives examples of some of the experiments he had conducted (Pulkki). The MDA Mixer Kit uses VBAP to be able to have the speakers be arranged in any configuration. In VBAP, loudspeaker configuration is arbitrary because the software compensates for the number and placement of the speakers. The loudspeakers can even be placed in a two-dimensional configuration. Vector based amplitude panning methods use a minimal amount of speakers at one time for each virtual source and can also compensate for bias in perceived direction by the listener when the speakers aren't placed symmetrically ("Vector Based Amplitude Panning").

Pro Tools

Pro Tools is the industry standard digital audio workstation, or DAW, made by Avid Technologies. It is used to record and mix audio in the music, film, and gaming industries. Pro Tools is a very versatile program. The software itself comes with a large variety of plug-ins that can do basic effects such as reverb, EQ, and compression. There are also many plug-ins available to purchase for Pro Tools that can do more precise effects, manipulate the audio in different ways, or add instruments for MIDI tracks. MDA Creator is a plug-in for Pro Tools, so it was essential to have Pro Tools in order to create multi-dimensional audio using the MDA Mixer Kit.

Avid, the company that created Pro Tools, provides extensive documentation on how to use all of the different features and extensions of Pro Tools. This documentation proved to be instrumental in the design of my user guide for the MDA Mixer Kit.

Not only did I use the design of the Pro Tools documentation as inspiration for my own guide, but it was necessary to know how to use Pro Tools somewhat efficiently in order to use the MDA Creator.

Psychoacoustics

Psychoacoustics is the study of sound perception. Sound is essentially vibrations through the air. When these vibrations reach the eardrum in the middle ear, they cause the bones in the inner ear to vibrate. The cochlea, the organ in the inner ear, translates the motion into neurological signals, which the brain interprets as sound (Nair). Being able to enjoy music or communicate orally is not the only purpose of hearing. Our ears have many more purposes, such as sound stimulation, or the excitement of the nervous system by auditory information,

and auditory localization (Leeds). Auditory localization, or the "judgments on the location, distance, movement, and size of a sound source based solely on auditory cues," is a key concept behind multi-dimensional audio. Based on what we hear, our brains can put together a mental map of what is around us (Nair). For example, when we hear a sound behind us, we can know the general location of the sound source without having to see it because of how the sound waves change when they reflect off of our surroundings and ourselves and because of the time delay in how long it takes for them to reach each ear. An audio engineer can simulate these effects to trick the brain into thinking there is a sound source where there isn't one, which is how multi-dimensional audio works.

Binaural Recording

Binaural recording is a recording technique using a dummy head with the microphones placed in the ears, as seen in Figure 1. Audio recorded using this technique sound very similar to the real-life experience because the sound waves traveled in a similar pattern to how humans actually hear the sound. Sound waves interact with the outer ear and surround space before reaching the inner ear. The sound that reaches each ear is also different because it may be louder on one side and it might reach one side before the other. The binaural system records these differences, so the resulting audio creates a 3 dimensional experience for a listener who is wearing headphones (Lalwani).

Figure 1. Binaural Dummy Head (Pike)

The MDA Mixer Kit is different than binaural recording because you don't have to use an expensive dummy head to record the audio and it can be reproduced using a speaker system. However, DTS uses a binaural system to figure out how sound waves change between a specific location and the inner ear of a listener. They can achieve this by playing a signal and recording it with a dummy head placed in the 'sweet spot' of the room and then comparing the recorded signal to the original. From this information they come up with an impulse map which shows where and how the sound waves are changing. They then incorporate that information into their software to create a multi-dimensional audio experience with loudspeakers.

Pulse-Code Modulation

Pulse-Code Modulation (PCM) is a lossless digital conversion of an analog signal. PCM is an uncompressed audio format, so the quality is really great. MDA uses PCM, which is one of the many reasons that it is so great!

My Project

My project is unique because Cal Poly did not previously have a space to mix multi-dimensional sound. There is also no documentation on how to use the MDA Mixer Kit because it is such a new technology.

Technology Overview

Hardware

The hardware involved in this project include the loudspeakers donated by DTS and the audio interface (M-Audio ProFire 610). All of the hardware was preinstalled.

The M-Audio ProFire 610 is the audio interface that connects the computer to the speaker system. It was initially chosen because it has eight channels of output, which is necessary to send sound to all of the speakers. It also uses a firewire connection, as opposed to a USB connection which is not as good for audio because of the way it transfers data. To use the ProFire 610, the driver must be installed, which can be downloaded from the support section of the M-Audio website.

Figure 2. M-Audio ProFire 610 Audio Interface

Software

The software needed for this project include the MDA Mixer Kit and Avid Pro Tools. The MDA Mixer Kit is the software that was intended to be used in the Game Design Lab when DTS donated the speakers. It is a plug-in, or extension, for Pro Tools, which is why Pro Tools was the chosen DAW.

Figure 3. MDA Creator Screenshot

MDA Mixer Kit

The MDA Mixer Kit is the software created by DTS to mix in a 3D space. It includes the MDA Creator and MDA Player. The MDA Creator is the actual Pro Tools plug-in. It has many features, which allow the user to place sounds around a three-dimensional space, to change the spread, aperture, and divergence of the sound, and to add track automation, among other things. The MDA Creator can also render the mix, export it as an MDA file, or export each track as a

separate wav file. The MDA Player is a separate application that is used to play back MDA files. It also has the option to play back videos at the same time.

Avid Pro Tools

Avid Pro Tools was chosen because it is the software that the MDA Creator works with. It is also the industry standard audio editing and mixing software for music, film, and video game audio.

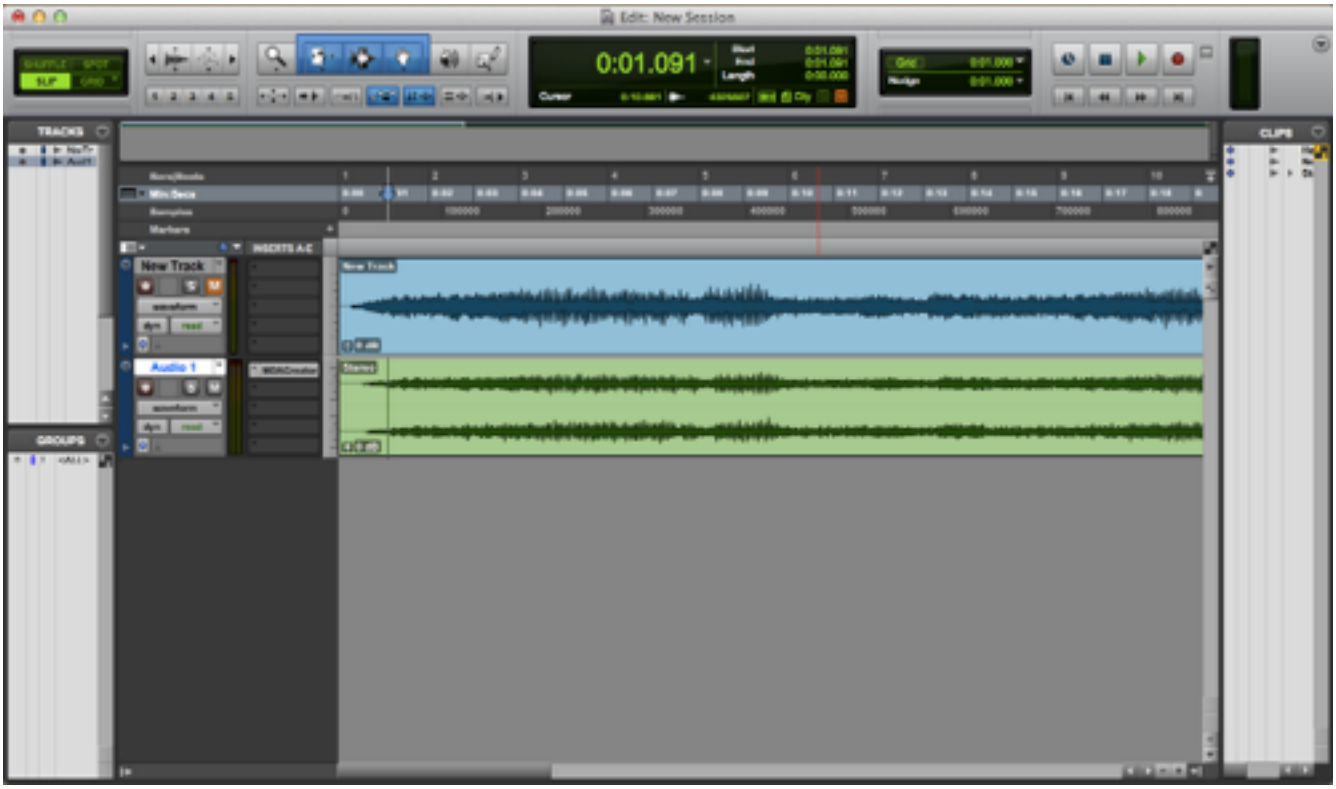

Figure 4. Pro Tools Screenshot

Design and Implementation

Timeline

January: Project refinement, started research
February: Research
March: Submitted IRB proposal
April: Acquired software, started playing with MDA
May: Trip to DTS, wrote guide, usability testing
June: edited guide, paper, presentation

Research

At the beginning of the project, I reached out to Jay Wyatt, a Liberal Arts and Engineering Studies alumni who is currently working at Ultra Stereo Labs, Inc. in San Luis Obispo. He uses the MDA Software for his work, so he was able to give me some topics to research. The topics he told me to research included:

- Traditional Surround Sound Mixing Techniques
- VBAP (Vector Based Amplitude Panning)
- Pro Tools

Later, I went on a field trip to DTS in Los Gatos with a team of Computer Science students led by Dr. Michael Haungs, who are working with DTS on a different project. The trip was still very relevant to my project because MDA was a large part of the discussion. Not only did I gain motivation and inspiration from this trip, but I also learned about some other areas to research which included:

- Psychoacoustics
- Binaural Recording
- Pulse-Code Modulation

Learning to use MDA

Learning to use the MDA Mixer Kit was mostly by trial and error. I was also able to ask Jay to verify if what I was doing was correct throughout the learning process.

Writing the Guide

I used the Pro Tools documentation as inspiration for the design of my guide. Some things that I took away from the Pro Tools documentation was the use of bold type to emphasize key words, how images were labeled, and how the sections were broken down. Some differences were that I didn't use columns in my guide . The organization of my guide was also different because I was only writing about one plug-in. Figure 5 shows the MDA Guide (on the left) compared to the Pro Tools Reference Guide (on the right).

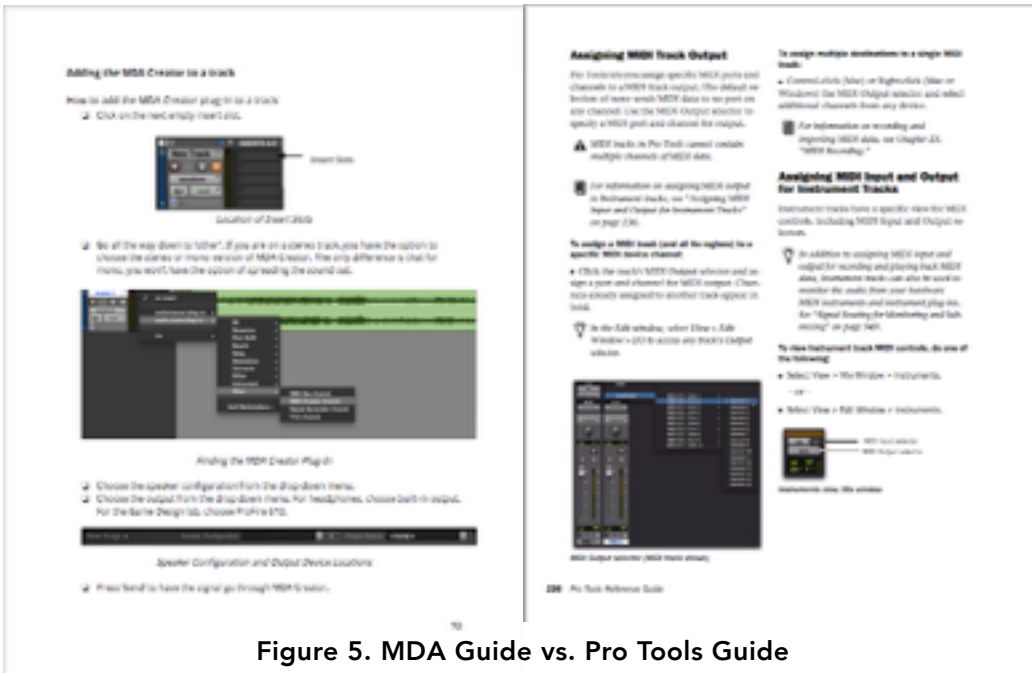

Figure 5. MDA Guide vs. Pro Tools Guide

The chapters in my guide included an introduction, an introduction to Pro Tools, an overview of the MDA Creator plug-in how to export, and how to play back an MDA file. The first chapter gave the purpose of the guide and a brief background of multi-dimensional audio and the MDA Mixer Kit. The introduction to Pro Tools gave the very basics of Pro Tools and all of the necessary features to use the MDA Creator. The chapter about the MDA Creator went included how to add it to a track, what each feature is, and what the settings meant. The chapter about exporting MDA went over how to render the mix and how to export it as either an MDA file or as separate wav files. The last chapter told the user how to play back and MDA file using the MDA Player.

Analysis and Verification of Success

I used two factors to evaluate my success in this project: the functionality of the workstation in the game design lab and an evaluation of the guide I created.

Functionality of Workstation

This portion of the analysis and verification of success was based on how well the hardware and software in the Game Design Lab were working by the end of the quarter. I created a gradation of how well the workstation functioned based on a scale from 1 to 5, with 1 being non-functional and 5 being working perfectly. I received a 4 on this section because although all of the hardware is connected correctly and all of the necessary software has been acquired and installed onto the designated computer, there was a minor problem that prevented the workstation from working as indicated in the beginning of the project. The problem was that the MDA Mixer Kit software is currently only available for Mac computers and the Game Design Lab computer is Windows. However, a Mac computer can be connected to the speaker system through the audio interface, which is what I ended up doing.

Usability Study

The tasks presented to the participants included the following two activities. The participants were asked to complete as they felt necessary in order to be able to evaluate the MDA User Guide. The research was approved by the Cal Poly Institutional Review Board and Human Subjects Committee.

Activity 1

1. Open Pro Tools and create a new session and call it ‘Activity 1’.
2. Create a new mono audio track.
3. Drag the file called ‘Fly.mp3’ onto the track that you have just created. Trim the clip so that it is 20 seconds long.
4. Insert the plugin called ‘MDACreator’.
5. Open the MDACreator and select the c51.vbap speaker configuration and the ProFire 610 for the output device. Press ‘Send’.
6. Make sure ‘Aperture’ and ‘Divergence’ are at 0.0 degrees.

7. Record the movements of the fly by creating an automation track (select all of the options) and moving the red dot around in the circle.
8. Put the automation mode back to 'Read' in the edit window and play back the sound. The red dot should move around on its own.
9. Render the track.
10. Export the track as and MDA file to the desktop and name it "Task1." A .map, .mda, and .mix file should appear.
11. Open the MDAPlayer application and select the appropriate speaker configuration and output device if they are not already selected.
12. Load in the MDA file you just created and press play. You should hear your sound play back.

Activity 2

1. Open the Pro Tools session called 'Activity 2' located on the Desktop. You should see three tracks.
2. Add the multichannel MDACreator plugin to the track called 'Rain' and select the speaker configuration, output device, and press send.
3. Set the spread and divergence to 0.0, the elevation to 90.0, and set the aperture so that it fills the room.
4. Insert MDACreator to the 'Helicopter' track and adjust the spread, aperture, and divergence each to about 20.0 degrees. Press send.
5. Record an automation track for the helicopter in both the 2D and 3D spheres. Set the automation mode back to read when you are done.
6. Insert the MDACreator to the last track. Press send.
7. Record an automation track of the footsteps going from left to right. Set the mode back to read when you are done.
8. Consolidate the helicopter and running tracks so that they are each the length of the rain track.
9. Play back parts of the session to make sure everything still plays.
10. Render the entire session.
11. Export the session as an MDA file and name it "Task2." A .map, .mda, and .mix file should appear.
12. Play back the .mda file using the MDAPlayer.

Upon completing as much as of the tasks as deemed necessary, the participants were asked to fill out a questionnaire evaluating the guide. They were asked the following questions:

1. What is your major?
2. What is your class level?
3. On a scale of 1-5, how experienced are you with sound design?
4. On a scale of 1-5, how experienced are you with Pro Tools?
5. On a scale of 1-5, how difficult would you say the tasks were?
6. On a scale of 1-5, how effective was the guide with helping complete the tasks?
7. On a scale of 1-5, how helpful were the images provided in the guide?
8. On a scale of 1-5, how would you rate the organization of the guide?
9. Comments or suggestions?

Results of the Study

I had six participants for my usability study from Liberal Arts and Engineering Studies, Music, and Engineering (Software, Computer Science, and Biomedical) majors. Based on my results, major and class level did not affect how each participant performed in the study. Performance was more influenced by sound design and Pro Tools experience.

The sound design experience of my participants ranged from no experience to some experience, as seen in Figure 6.

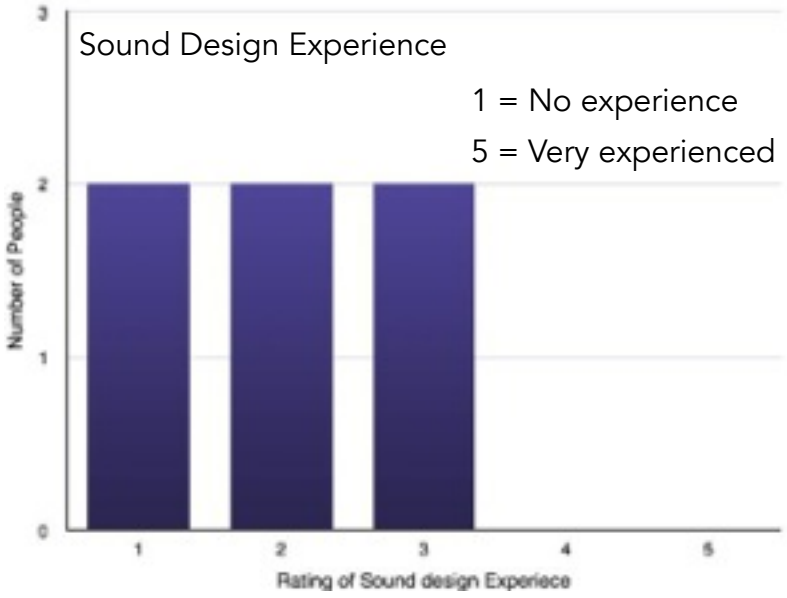

Figure 6. Sound Design Experience of Participants

They also had little to no experience using Pro Tools, as indicated in Figure 7.

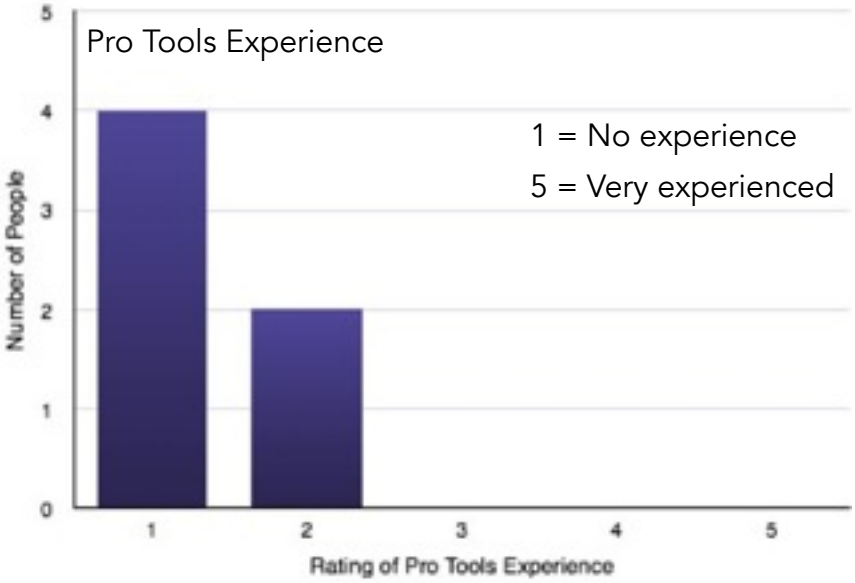

Figure 7. Pro Tools Experience of Participants

The difficulty rating of the tasks I presented varied from very easy to difficult and were split fairly evenly, as seen in Figure 8.

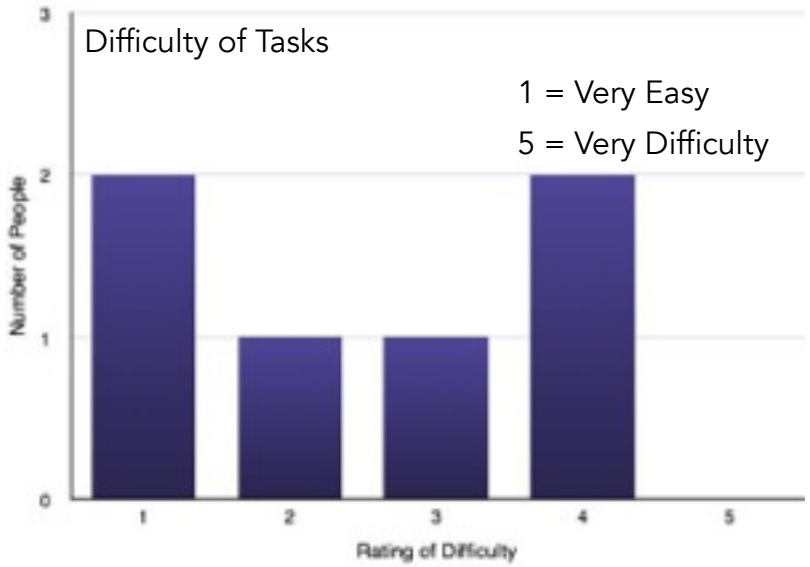

Figure 8. Rated Difficulty of Tasks Presented

Overall, my guide scored fairly well. I received a 3.167 out of 5 for the images, 4 out 5 for the organization, and 3.67 out of 5 for the overall helpfulness of the guide.

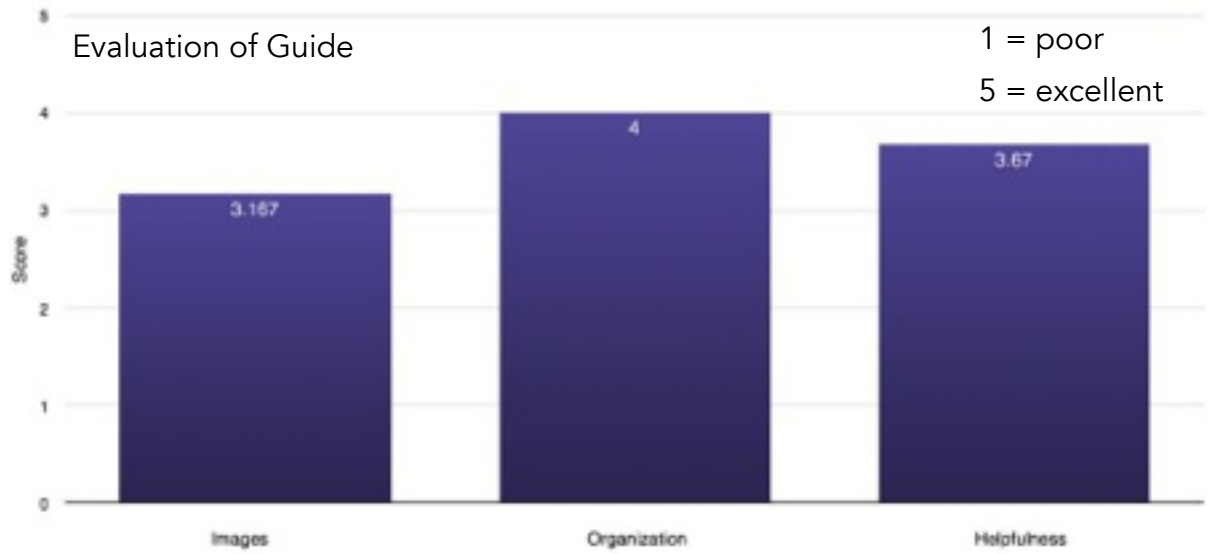

Figure 9. Ratings of Images, Organization, and Helpfulness of Guide

I also gained valuable feedback from the questionnaire. The most common suggestion was to include more pictures and diagrams in the guide.

Societal Impacts

More Sound Design at Cal Poly

Although Cal Poly does have a sound design program through the Music Department, it only offers three classes and the studio is very small and ill-equipped. There is interest in sound design and audio engineering at Cal Poly, which is apparent from the existence of the Audio Engineering Society, which is a club on campus, the growing popularity of LAES and the Media Arts and Technology minor, and the number of music majors concentrating in sound design. My project will hopefully give the students with a passion for sound design another outlet to gain experience not only in audio engineering, but also in a new technology that is not available at other schools. Another way that my project could increase the amount of sound design at Cal Poly would be to peak the interests of students who are not yet interested in audio engineering.

Students can create Multi-dimensional audio for multimedia projects

Another impact my senior project could have on the Cal Poly community is to give students the opportunity to create multi-dimensional audio for their multimedia projects, such as films or video games. The entertainment industry is increasingly embracing immersive entertainment, and students at Cal Poly have the unique opportunity to get experience with this new technology. Having multi-dimensional audio in their projects would look really impressive on their resumes and it would give Cal Poly more student projects to showcase.

Sustain Cal Poly's Relationship with DTS

Cal Poly already has a great relationship with DTS, and through my project, I hope to get more students interested in immersive audio so that they will be motivated keep up this connection with a great company. DTS will also hopefully see Cal Poly as a valuable partner and its students as future members of the industry. I hope that in the future, DTS will want to collaborate on even more projects with Cal Poly students.

Future Work

Students Use Guide

The most beneficial future work for my project would be for students to use the guide. The whole purpose of my project was to have the speakers in the Game Design Lab be used for their intended purpose, which is to create multi-dimensional audio assets. The next step is for students to use them for that purpose, and to use the guide as a reference at the same time.

Update Guide

The MDA Mixer Kit is currently a Beta version. As DTS continues to update their software, it is important for the guide to be updated as well so that students who are new to MDA can still use it. Updates to the guide may include new features of the MDA Creator plug-in or MDA Play application, new screenshots of the interface if it changes, or new sections for additional features. It may also be helpful to perform more usability tests as the guide changes to make sure that it is as helpful as possible.

Make Game Design Lab more ideal for Sound Mixing

Right now, the workstation in the Game Design Lab is located in the corner of the room, as seen in Figure 10. This is not ideal for sound mixing because the sound designer would be closer to the corner speaker and hear the output of that speaker louder than the rest of them. The ideal location for the mixing station would be in the center of the room so that the sound designer could hear how the mix sounds from the 'sweet spot,' or from where it sounds the best (Figure 11).

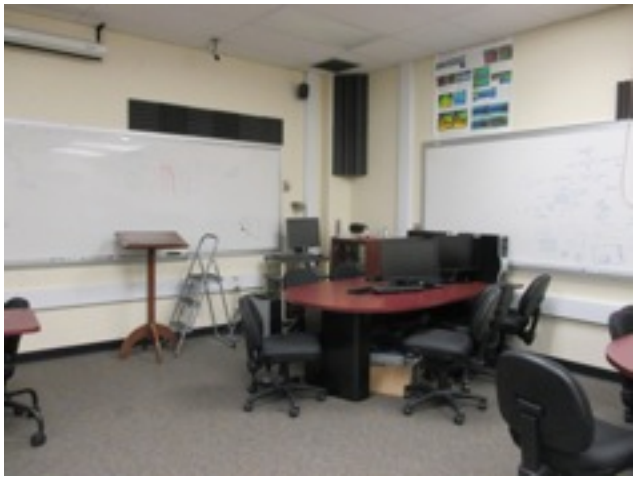

Figure 10. Current Location of the Mixing Station

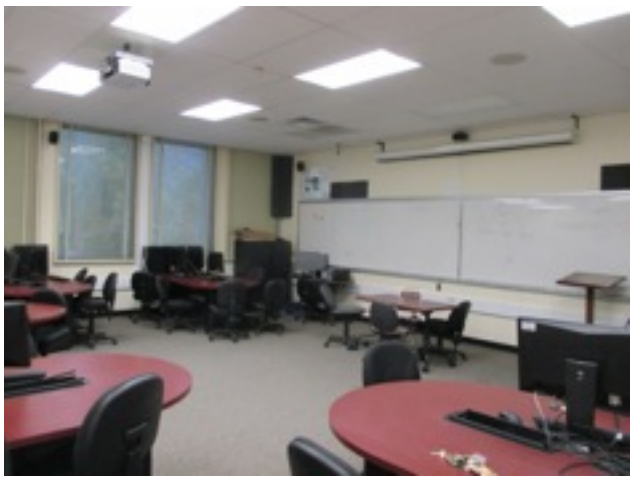

Figure 11. Ideal location for Mixing Station

However, the Game Design Lab is also used for classes, so the station would have to be able to roll out to the center of the room. This presents a challenge because of the cables and hardware that are part of the workstation.

Another improvement that could be made to the workstation would be to replace the Windows computer with a Mac. This is not absolutely necessary, though, because it is possible to connect a Mac laptop to the audio interface.

Conclusion

Overall I am very pleased with my project. What I am most please about is that Cal Poly has the software to create multi-dimensional audio and that all of the hardware is connected and working correctly. I am also very happy that at least the students working on the other project with DTS are going to be using MDA and that it is likely that they will use my guide.

As for the guide, I am also pleased about how it turned out. Based on my usability study, the organization seems to be intuitive and now that I've added more images, I hope it will be even easier to use so that more people will create multi-dimensional audio and the speakers will be put to good use. I also hope that sound design and audio engineering continues to grow at Cal Poly.

On a personal note, I am very happy that this was my senior project. I learned a lot about sound design and it was a wonderful opportunity (and excuse) to research topics that I have a lot of interest in, such as psychoacoustics and different recording techniques. I also learned about topics that I had no knowledge of before starting this project, such as vector based amplitude panning and pulse-code modulation. Another thing I learned about over the course of this project is the importance of being persistent and how to do so politely, which I learned when trying to get the MDA software.

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Appendix A: MDA Mixer Kit User Guide

MDA Mixer Kit User Guide

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Senior Project
2015

1

Contents

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Chapter 1: Introduction

The purpose of this guide is to be a guide for people who want to create 3D audio assets. This is a guide on how to use the MDA Mixer Kit, made by DTS (Digital Theater Sound). MDA stands for multi-dimensional audio, and the mixer kit is has two components: the MDA Creator, which is a plug-in for Pro Tools, the industry standard digital audio workstation, and the MDA Player, which is the application which plays MDA files.

Origin of the Project

In the Spring of 2013, DTS donated some speakers to Cal Poly, which were installed in the Game Design Lab in the Computer Science Building, with the intended purpose of being used to create 3D audio. This guide was created so that future students will be able to use the speakers and the resources DTS so kindly donated and create multi-dimensional sound assets for their projects.

What is MDA?

MDA is a tool used to create content for DTS X, an object-based audio codec. Object-based audio is a relatively new technology. It is an immersive form of audio that is used in cinema and now in video games, especially with the emergence of virtual reality. Object based mixing is differs from traditional channel-based mixing because the audio engineer can choose where a sound originates and move it around independently, rather than being limited to a certain number of speakers.

How does it work?

The technology behind MDA is based on psychoacoustics. The idea is that when we hear a sound, the sound waves are reaching our eardrums after they bounce off of the walls, our shoulders, our ears, and anything else in between the source and our ears. What we actually hear has been changed very slightly from its original source wave. Based on these changes, our brains put together a mental picture of where the sound is coming from, and by emulating these changes, we can simulate a three-dimensional audio experience. Audio engineers can measure how the signal changes using technology called binaural recording, which consists of a dummy head with microphones in its ears to record as close as possible what we actually hear. A signal is emitted and recorded, using binaural recording. The recorded audio is run through filters to compare it to the original signal and find out where the impulses are. This information is used to create a life-like audio simulation, or multi-dimensional audio.

Downloading MDA/Pro Tools

The LAES department has a copy of Pro Tools 12. The software can be downloaded onto any computer logging onto the LAES account on the Avid website.

You will need the LAES iLok (USB dongle containing authorization information) in order to use Pro Tools. Additional iLok dongles can be purchased and authorized for the LAES account.

MDA is currently only available for Mac computers.

Working in the Game Design Lab

The Speakers in the game design lab are connected to the M-audio ProFire 610 audio interface. The interface uses a firewire to firewire connection. In order to use the ProFire 610, the driver needs to be installed, whcih can be found here:
http://www.m-audio.com/support/download/drivers/profire-series-driver-v2.4.4-mac

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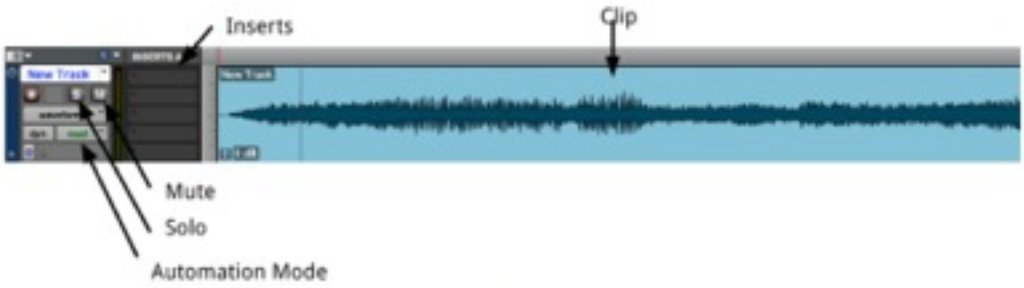
Chapter 2: Introduction to Pro Tools

Avid Pro Tools is the industry standard DAW, or Digital Audio Workstation. MDA Creator is an extension of Pro Tools, so it is very important to know some of the basics.

Important Vocabulary:

- **Session**: the Pro Tools work file
- **Track**: where the audio is edited



Example of a track

- **Solo**: turn on to listen to the track by itself
- **Mute**: turn on to listen to the session without the track
- **Inserts**: where plug-ins, sends, or buses can be added to a track
- **Automation Mode**: the different ways the changes to an effect are recorded or played back
- **Clip**: an individual piece of audio within a track
- **Plug-Ins**: effects or instruments that can be inserted onto a track
- **Sends**: sends the track to an auxiliary track called a bus so that effects can be applied to multiple tracks at one time
- **Buses**: auxiliary tracks with effects or instrument plug-ins

The Basics:

- **Creating a New Track**: go to Track > New Track in the menu bar, or press Command + "N" for Mac or Control + "N" for Windows; choose the type of track and press "Create."
- **Adjusting the Length of a Clip**: there are three ways to change the length of a clip
  - Highlight part of the clip and press delete
  - Hover the mouse near either end of a clip until a bracket appears, then click and drag the edge of the clip to the desired length
  - Click the upper half of the clip at the desired length, press Command + "E" for Mac or Control "E" for Windows to cut the clip at that spot, and delete the extra part
- **Highlighting**: highlight a piece of a clip by clicking on the upper half of a track and dragging or highlight the whole clip by clicking once near the bottom of the clip
- **Moving Clips**: hold down on the bottom half of a clip and move to the left, right, or to a different track
- **Playback**: press the green arrow and black square or press the spacebar to play and stop; pressing enter goes back to the beginning of the session

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- **Windows**: Pro Tools has many screens that can be viewed, but the two main windows are the edit and mixing windows
  - **Edit Window:** where the audio can be viewed and edited

Edit Window

  - **Mixing Window:** where the faders are located and where the sound levels are adjusted and balanced

Mixing Window

  - Switch between windows by pressing Command + "=" for Mac or Control + "=" for Windows

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Chapter 3: MDA Creator

The MDA Creator is the tool used to make a track multi-dimensional. Each track must have the MDA Creator plug-in as an insert.

MDA Creator

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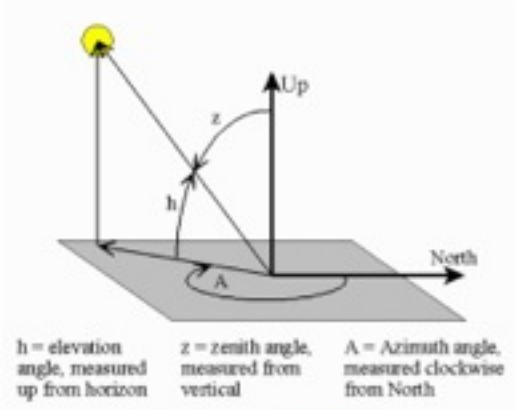
Overview of MDA Creator's Features

- **Spread:** how far apart the left and right sources are for stereo objects
- **Aperture**: how wide the sound reaches
- **Divergence:**
- **Elevation**: the angle between the ground and the vector from the center of the room to the object.
- **Azimuth**: the angle between the vector from the center to the front of the room and the perpendicular projection of the object down to the ground



Elevation and Azimuth

- **2D vs 3D**: By pressing the 2D button so it lights up, the interface changes to a flat view of the space where the x and y coordinates of the object can be changed.

3D mode vs 2D mode

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- **Trim**: This is a gain feature. You can make objects louder or quieter by adjusting the slider.

Trim Slider

- **Solo/Mute**: The solo and mute buttons affect the track that you are currently editing. Pressing solo will mute the rest of the tracks while pressing mute will mute the track you are on. Just don't forget to turn the buttons back of when you are done.

- **Send:** Sends the audio through the MDA Creator

Send, Solo, and Mute

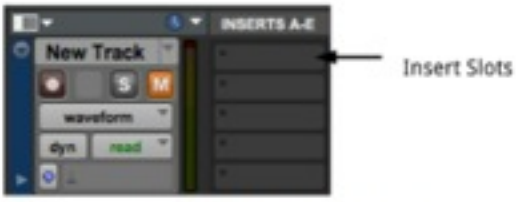
- **Bypass**: The bypass button, located near the top, will bypass the effect of the MDA Creator for the track. It is useful if you want to hear the difference between the original track and the edited version.

Bypass

Adding the MDA Creator to a track

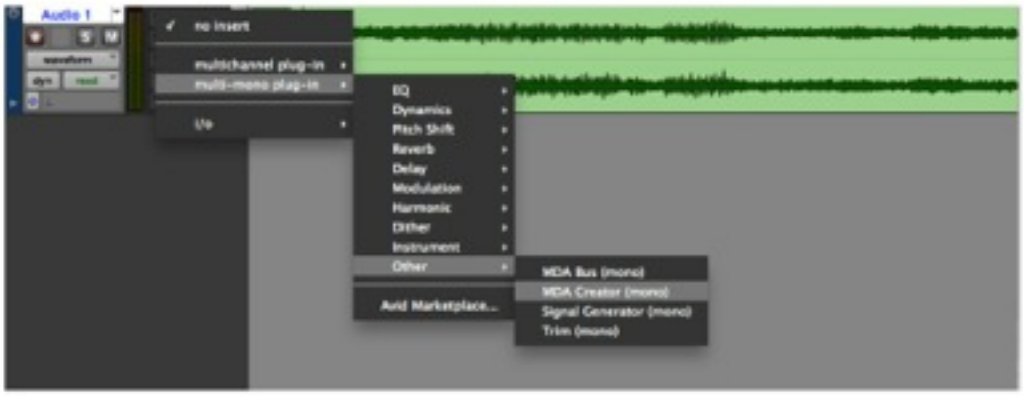
How to add the MDA Creator plug-in to a track:

- ❑ Click on the next empty insert slot.



Location of Insert Slots

- ❑ Go all the way down to 'other'. If you are on a stereo track, you have the option to choose the stereo or mono version of MDA Creator. The only difference is that for mono, you won't have the option of spreading the sound out.



Finding the MDA Creator Plug-In

- ❑ Choose the speaker configuration from the drop-down menu.
- ❑ Choose the output from the drop-down menu. For headphones, choose built-in output. For the Game Design lab, choose ProFire 610.

Speaker Configuration and Output Device Locations

- ❑ Press 'Send' to have the signal go through MDA Creator.

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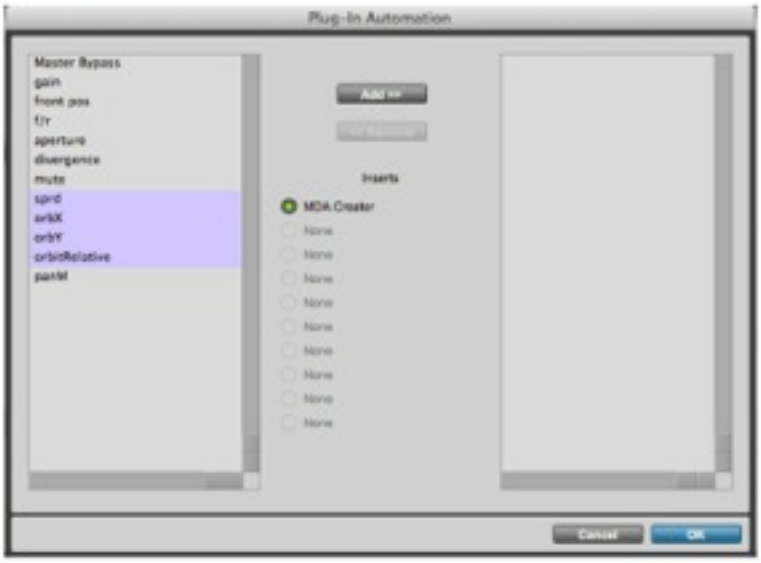
Adding Track Automation

Like most plug-ins, you can add track automation, which means that Pro Tools can record the changes you make to a plug-in so that it does the same thing every time. This is useful in MDA because if you want a sound to move over time, you can record that movement. This is how to add track automation:

- Click on the rectangles by the word 'Auto'.

Location of Track Automation Button

- It will open up the Plug-In Automation window with a list of functions that the MDA Creator can perform.



Plug-In Automation Menu

- Add whichever effects you want to be able to automate by highlighting them and pressing add. The reason Pro Tools doesn't automatically do all of them is because it is trying to lower the CPU load. When in doubt, choose all of them. Then press 'OK'.

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- On the Edit Window in Pro Tools, click on the button that says 'Read' in green and change it to 'Latch'.

Different Track Automation Modes

- Press enter to go back to the beginning of the track.
- Press the spacebar to play and move the red dot according to where you want it to go with the sound.
- Repeat until you're satisfied with your automation.
- When you are done, change 'latch' back to 'read'. Play it back and watch the little red dot move by itself!

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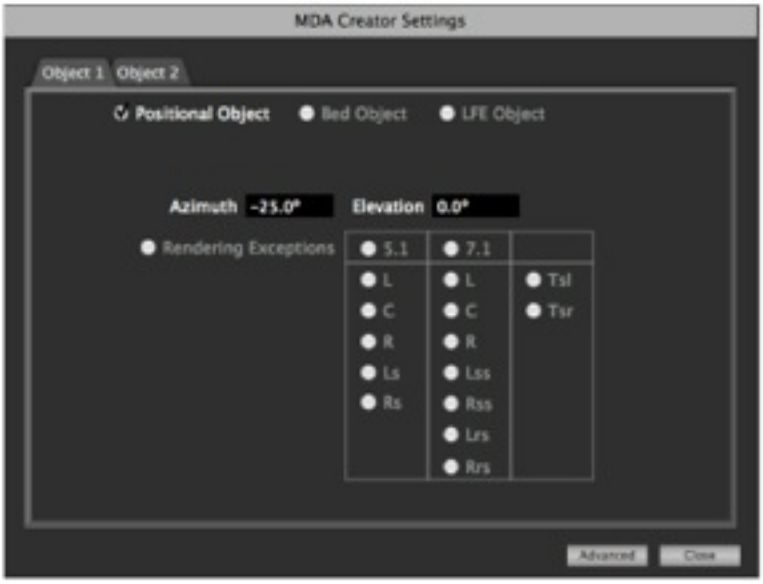
Settings



Settings Window

The settings in MDA creator are for:

- Changing the type of object
  - **Positional Object**: objects can be positioned anywhere in the soundfield
  - **Bed Object**: object is part of a 5.1 or 7.1 "bed" and cannot be moved
  - **LFE Object**: low frequency effect objects
- Changing the Azimuth and Elevation angles
- Adding Rendering Exceptions: renders everything except for audio assigned to output from an assigned speaker
  - 5.1: speakers in a 5.1 surround sound setup
  - 7.1: speakers in a 7.1 surround sound setup
  - Tsl/Tsr: top side left/top side right loudspeakers

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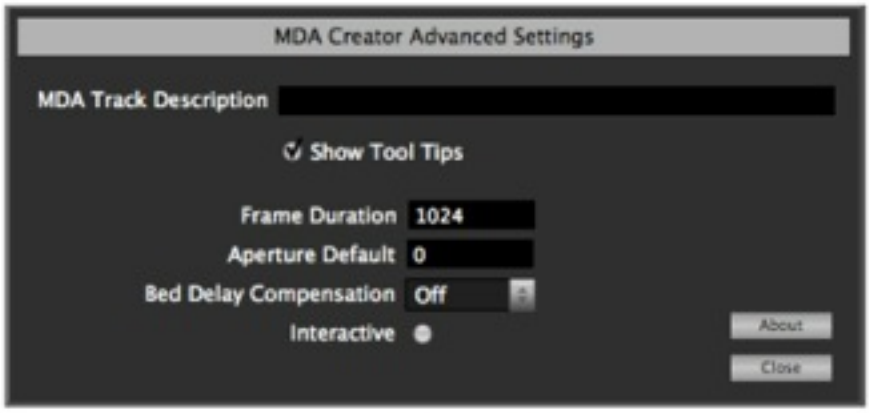
Advanced Settings:



Advanced Settings Window

- MDA Track Description: option to add description about the MDA track
- Show Tool Tips: shows or hides text box that appears when mouse is hovered over features in MDA Creator
- Frame Duration: how many samples per video frame
- Aperture Default: the default aperture level for new objects
- Bed Delay Compensation: set to the playback engine buffer size for bed instances in an auxiliary bus
- Interactive: an experimental feature that plays the objects for an instance through the entire bitstream, even if the object is silent

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Chapter 4: Exporting

There are two ways to export using the MDA Creator. The first is to export as an MDA file. The second is to export as separate wav files for each track. Either way, it is necessary to render the mix before exporting.

Things to know

- ❑ All the tracks have to be the same length.
- ❑ To make a track longer, highlight the final length of the track, go to Edit>Consolidate track in the menu bar. The track will now be the length that was highlighted.

Rendering the mix

Rendering the mix is processing it with all of the metadata information. This is a necessary step before exporting the audio.

- ❑ Highlight the entire track in the Edit Window.
- ❑ In MDA Creator, click on the Render tab on the bottom if you're not already in Render mode.

- ❑ Press play.
- ❑ Wait for the session to finish playing.
- ❑ The session is now rendered.

Exporting MDA file

Exporting as an MDA file will create three files, a .map, .mda, and .mix file. All of these are important so make sure all of them get created. When you export an MDA file, all of the tracks are mixed down into one MDA file.

- ❑ Make sure your session is rendered.
- ❑ Highlight the entire duration of the session to be rendered.
- ❑ Click on the Export MDA tab at the bottom. A window will pop up asking where you want to export to.
- ❑ Fill out the box with the name of the file and where you want it saved and press OK.
- ❑ Press play and wait for the session to play out. When it reaches the end of the highlighted section, it will stop automatically.
- ❑ There should be three new files in directory where you saved them.

Rendering to Disk

Rendering to disk is a way to export each track as a wav file with the MDA effect.

- ❑ Make sure the session is rendered.
- ❑ Highlight the length of the section you want to render to disk on one or more tracks.
- ❑ Click on the Render to Disk tab at the bottom. A window will pop up asking you where to save.
- ❑ Fill out the information and click OK.
- ❑ Press play and wait. It will stop automatically at the end of the highlighted section.
- ❑ When it finishes, the wav files should be where you selected to save them.

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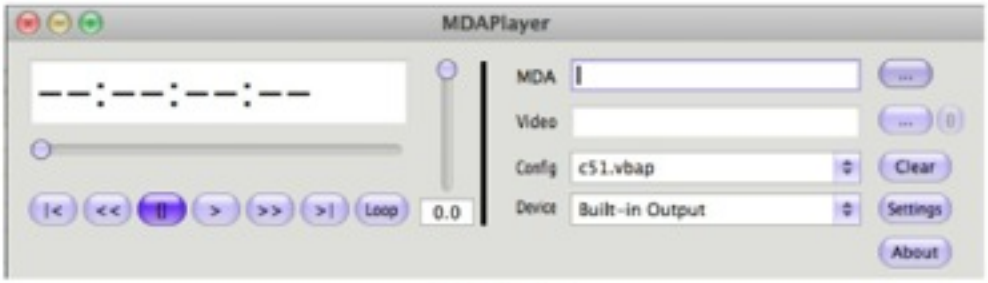
Chapter 5: Playing Back an MDA File

In order to play back and MDA file, you need to use the MDA Player.



MDA Player

Overview

- The MDA slot → where you select the file to be played.
- The video slot → where you can open a video if you want them played back at the same time.
- Config → speaker configuration.
- Device → playback device.
- > → play
- |< → go back to the beginning
- << → rewind
- >> → fastforward
- >| → skip to the end
- Loop → loop the file
- Slider → gain meter where you can adjust the volume.

Playing back an MDA file

- Select a speaker configuration and output device using the dropdown menus.
- Select an MDA file to play back by clicking the button with the three dots next to the MDA slot and navigating to the file you are searching for.
- If you have a video to play it back with, select the video by clicking on the button with the three dots next to video slot and navigating to it.
- Press the '>' button to play.

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